

### **REMARKS**

Claims 11-19 are currently pending in this application. The recent telephone interview so courteously granted by Examiner McKenzie and Primary Examiner Smith is hereby noted with appreciation.

Claims 11-14 stand rejected under 35 U.S.C. § 103(a) as obvious over DD 145540A to Janzen et al. (hereinafter also referred to as “Janzen”). Janzen does not render obvious the present invention.

According to the present invention, the 1st stage of the gas purification of, for example, a DMT-comprising gas is carried out at or below the melting point of, for example, DMT, i.e., butanediol has in every case a temperature about 140°C, since this is the melting point of DMT. Since the gas stream comprises DMT, it is important for the total process to work at or below this melting point in the 1st stage (see page 6, line 6 ff).

From page 7, line 24 ff, it is stated in the present specification that the gas stream is cooled in the 2nd stage but the 2nd stage is carried out above the melting point of the diol, i.e., in the case of butanediol this would be above 19°C, in the case of ethylene glycol or propanediol above -10°C or -32°C, respectively. Since the claim speaks of a process for purifying and cooling gas streams, it can be seen, with simultaneous interpretation of the description and examples, that both process steps are not to be carried out at the same temperature (see also preferred embodiment for DMT and butanediol on page 8, from line 7 ff); first purification, then cooling.

In the present claims, the choice of words in no way refers (both times) to the melting point of the diol, such that a two step process is clearly shown. Since a two-stage process is claimed, the claimed process is clearly novel over the cited prior art.

As the table below shows, the cited documents disclose either only cooling using other scrubbing media or purification. Applicants note that it is relevant to the subsequent discussion of the inventive step that the prior art all either cools or purifies, i.e., never describes a combination of these two modes of operation.

A significant improvement of the claimed invention is that DMT can be separated off

from a gas stream without formation of industrially very difficult-to-handle DMT solids (desublimates) and the gas stream which has been purified in this way can subsequently be cooled without solids formation. It is achieved industrially by means of appropriate temperature and concentration conditions in the two stages of the process, which cannot be derived from the documents cited.

To further demonstrate the non-obviousness of the present invention, as discussed during the interview, attached is a Declaration by Dr. Loening, one of the named inventors of this application. The declaration was not earlier presented since it was believed that the remarks in the prior response would be sufficient to overcome the rejections. Furthermore, it was not earlier presented since it required additional time to obtain since Dr. Loening now works in a different unit of the assignee than the research lab where this invention was developed. The Declaration shows that single stage scrubbing and cooling of the gas streams according to the prior art has severe technical disadvantages. In the example a) in the Declaration using a temperature of 124°C, the cooling of the gas stream was insufficient and an increase in the loss of 1,4-butadiene from the top of the column occurred. In the example b) in the Declaration using a temperature of 60°C, super saturation of the gas phase with DMT in the column and in the gaseous outlet of the column occurred. The temperatures in the comparative examples were selected since the specific working example in the specification employs 124°C in the first stage and 60°C in the second stage.

In Janzen et al., “2 stages” are formally indicated for purification, but the 2nd stage is preferably carried out at 110-130° (see claim 1); a combination is not encompassed or recommended de facto according to the claimed invention. Even assuming *arguendo* if 2 different stages are indicated, this “2nd stage” is in no way technically comparable to the claimed process step.

Further, in Janzen et al., a gas is pushed through a liquid (see figure), which leads to an extreme pressure drop (is not technically comparable to “quenching”). Even if the liquid were here to reach the indicated 20°C, the contact time is not sufficient to cool the gas due to the circumstances of the apparatus. If appropriately long contact times were to be employed, cooling would still not be appreciable and the mode of operation would also become uneconomical.

On entering this stage, a tremendous pressure drop occurs (from a gauge pressure 500

mbar to ambient pressure on exit). Downstream of this, the stock tank would have to be designed appropriately for  $1013 + 500$  mbar gauge pressure, i.e. about 2 bar. However, this would lead to an increase in the thickness, larger pumps, etc. In summary, these lower limits cannot be achieved technically using the apparatus and mode of operation described in Janzen et al.

Correspondingly, it is also stated on page 2 of Janzen et al. that (last 4 lines, middle paragraph) an additional discharge (water separator) is required because of entrained volatile components.

Claim 15 stands rejected as obvious over Janzen et al. in view of US Patent No. 6,312,503 to Fike et al. (hereinafter also referred to "Fike"). Fike does not overcome the deficiencies of Janzen with respect to rendering unpatentable the present invention.

Although Fike describes a multistage process, the process fundamentally differs in principle and thus has clear disadvantages compared to the claimed process. For instance, whereas in the present invention, the first stage for removal of the ester from the gas phase is achieved by means of a gas scrub and the gas is subsequently cooled by means of a cold liquid (quenching) in a second stage, in Fike, the gas is firstly cooled at very low temperatures and the ester is then scrubbed out. Here, aerosol/mist formation is to be expected in the first stage due to the tendency of the system to desublime in the present case of DMT; this is avoided in a targeted manner by means of the present invention, i.e. no desublimation occurs.

Moreover, in Fike, the temperature is at no point in the vicinity of the melting point of DMT and this document also gives no suggestion of a combined mode of operation.

Claims 16-19 as obvious over Janzen et al. in view of DD 160829 to Serenkov et al. (hereinafter also referred to as "Serenkov"). Serenkov does not overcome the deficiencies of Janzen with respect to rendering unpatentable the present invention.

Regarding Serenkov, the transesterification by-product methanol is distilled off, carrying DMT with it. According to the present invention, under pressure the DMT is dissolved in butandiol and the methanol is collected in a receiver.

BD and DMT go directly back to the reaction (transesterification). No cooling is described.

In addition, Serenkov does not make gas cooling possible and also does not render a

combination with scrubbing obvious.

<b>Document/ Patent</b>	<b>Scrubbing medium</b>	<b>Apparatus</b>	<b>Remarks</b>	<b>Mentioned in application - Differentiation</b>
DD 160829  Serenkov et al.	1,4- Butanediol	Absorption column	DMT-comprising vapor stream from PBT reactor, carrier gas = MeOH, scrubbing with 1,4-butane-diol in countercurrent, recirculation of butanediol/DMT mixture to reactor	Page 1, line 40- Page 2, line 4  * no cooling described
DD 145540  Janzen et al.	Glycol	Chamber vessel with bubble column + scrubber multistage	Storage of molten DMT, glycol used as scrubbing and barrier liquid, recirculation of DMT to process	Page 2, lines 20-32  *no cooling described  *high pressure drop due to barrier liquid
US 6312503  Fike et al.	Ethylene glycol	Countercurrent scrubber, multistage	Stripping of gas streams from PET reactor, gas stream comprising monomers + second reaction components, lower apparatus section = gas cooling, upper apparatus section = gas scrub, no DMT in the offgas mentioned	Page 3, lines 4- 18  *only cooling  *principle incorrectly described  *no recovery of material of value

Overall, some “multistage” work-ups are mentioned, but either only cooling or only scrubbing is carried out. In the case of “only cooling”, sublimate formation occurs. In the case

of “only scrubbing”, hot off gas (not permissible) is formed, there is a very high gaseous output and DMT is lost in relatively large amounts.

As such, in view of the several differences and deficiencies, claims 11-19 are clearly novel and unobvious over the above-cited documents, alone or in combination. Therefore, reconsideration and withdrawal of the rejections are requested.

### **CONCLUSION**

In view of the above remarks, Applicants believe the pending application is in condition for allowance.

In the event the Examiner believes that another interview might serve in any way to advance the prosecution, the undersigned is available at the telephone number noted below.

The Commissioner is hereby authorized in this paper to charge payment or credit any overpayment to Deposit Account No. 03-2775, under Order No. 12810-00347-US from which the undersigned is authorized to draw.

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Respectfully submitted,

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